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and *integrata* var. *sorediosa*, apart from the difference in distribution, the anatomy of the thallus and the darker coloration of the under side would serve as a distinction.

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PRELIMINARY NOTES ON THE LICHENS OF WHATCOM COUNTY, WASHINGTON¹

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Whatcom County occupies the northern one of the northwest corners of the United States, as the state of Washington has what one might well call two northwest corners. This is due to the folding of the international boundary which turns southward from the 49th parallel to the strait of Juan de Fuca and then westerly to the Pacific. The county, which has a length of about 90 miles with a north and south breadth of 25 miles, has an area of 2226 square miles.

Excluding Lummi Island which lies just off the southwest corner of the county and which attains a height of about 1800 feet, the county is all on the mainland. It divides naturally into two physiographic provinces; the western fourth is largely a forest covered plain, consisting of the valleys of the Nooksack and Sumas rivers and the rolling uplands between them and southward, much of it less than 100 feet above sea level. It is bounded on the west by the Gulf of Georgia and Puget Sound; the remaining portion of the county lying to the eastward of this region of little elevation is covered by the Cascades. The plain is crossed from east to west by the Nooksack river and its tributaries but in the main the original topography has been greatly altered by glacial action and deposits which destroyed the old drainage, leaving many gravelly eskers, kames, ponds, sphagnum swamps, cranberry marshes, and peat bogs. The western fourth of the county contains all the cleared land and practically all the population.

The eastern three-fourths is a wild and little visited region of exceedingly rugged mountains which form a maze of irregular ranges. The main divide of the Cascades here has an elevation of between 6000 and 7000 feet and is clad in perpetual snow. Several peaks range from 8000 to 9000 feet in altitude while the mountains culminate in Mt. Baker, a huge volcano 10,780 feet in height. Mt. Baker and Mt. Shuksan have many large glaciers on their flanks, while a few hundred feet below the dome-like summit of Mt. Baker, at the so-called crater, is a vent from which come sulfurous gases and vapor.

Excluding the arctic realm of the higher mountains, and the alpine meadows more or less common above 5000 feet, the entire region was originally covered by the typical dense coniferous forest of the Puget Sound Valley. The principal lumber trees were and still are *Pseudotsuga mucronata* and *Thuja plicata*, though the giant trees reaching a height of from 200 to 300 feet have practically

¹ Presented at the December, 1916, meeting of the Sullivant Moss Society, New York City.

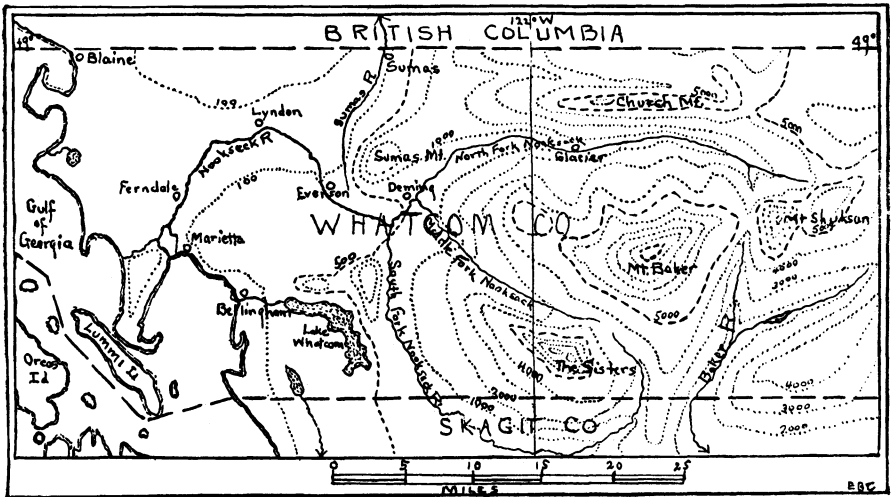


FIG. 1.—Sketch-map of the western portion of Whatcom County, Washington.

disappeared from the inhabited district. The above often originally formed nearly pure stands over large areas but mixed with them occur more or less frequently *Tsuga heterophylla*, *Abies grandis*, and *Picea sitchensis*. Now and then in a bog is found a patch of *Pinus contorta*. In the higher mountains are extensive forests of *Tsuga mertensiana*, and still higher are four species of *Abies*, *Taxus brevifolia*, and *Chamaecyparis nootkatensis*. *Pinus monticola* is occasional at all altitudes.

Intermingled with the conifers are patches of greater or lesser extent, especially on low ground, of various deciduous trees. *Alnus oregana* is the most abundant of these; *Betula occidentalis*, *Acer macrophyllum*, *Acer circinatum*, *Prunus emarginata erecta*, *Populus trichocarpa*, *Pyrus diversifolia*, *Pyrus sitchensis*, *Rhamnus purshiana*, *Salix lasiandra Lyallii*, and *Salix scouleriana* are practically all the trees of any importance.

Weather records kept at Bellingham for a number of years past show a mean annual precipitation of about 31.5 inches. Back a few miles from salt water the rainfall is two or three inches less, with much greater extremes of both heat and cold. At my home twelve miles from Bellingham the thermometer has dropped to 8 degrees below zero, Fahr., and has risen to over 90 degrees above. The rainfall is mostly distributed through the winter and spring months; in the summer the precipitation is scanty or even altogether absent for several months, but throughout the year there is a good deal of foggy or cloudy weather. The western portion of Whatcom County lies in the rainshadow of the Olympics and the mountains on Vancouver Island, hence the relatively light precipitation. As one ascends the Cascades the rainfall rapidly increases, so that at a height

of a few thousand feet it rises to 80 or 90 inches, or even more. The average annual snowfall in the western portion is 10 inches, but every few winters there may be three or four feet of snow on the level, while every winter in the higher mountains it falls to a depth of 20 or 30 feet.

In this rainy mountain belt lichens grow to a greater size and are much more evident than elsewhere. From about 1000 to 3000 feet the *Lobaria pulmonaria* formation is dominant; *Cetraria glauca*, *Cetraria lacunosa stenophylla*, *Sphaerophorus globosus*, and several *Usneas* of only moderate size form the chief secondary elements of this formation.

For the next two thousand feet *Lobaria oregana* is the principal lichen, absolutely covering the basal portions of the trunks of the hemlocks which here compose most of the forest.

Just below the timber line the *Alectoria* formation becomes notably conspicuous, the chief elements in it being *Alectoria jubata implexa*, *Alectoria sarmentosa*, *Usnea plicata*, and *Nephromopsis platyphylla*.

Above the snow line earth lichens are abundant on the patches of soil exposed, and rock lichens occur on some of the rocks which for the most part are bare. Their occurrence, so far as yet known to me, will be noted in the list following.

In the lowland forested region earth lichens are comparatively rare, while rock lichens are altogether absent except on an occasional erratic glacial boulder. Several species of *Peltigera* are common on earth but hardly abundant enough or sufficiently confined to earth to be named as a separate formation, unless it might be *Peltigera aphlosa*. The original botanical features of this region are very rapidly vanishing; not only has the primeval forest practically disappeared, but the logged off lands are rapidly becoming altered through the combined influences of the annual increase in the area of cleared land, and the ravages of great fires which sweep over many square miles nearly every year. But for many years the eastern portion of the county will furnish to the adventurous and hardy, able to pick a way through the pathless wilderness and carry necessary supplies, a glimpse into the virgin wilderness.

It is quite evident that lichens have never been so prominent an ecological factor here as in some other regions, as for instance the Santa Cruz Peninsula, California. Mosses and liverworts are here so conspicuous that they make our lichens quite insignificant. There are here none of the enormous expanded *Parmelias* and other foliaceous forms, or dense masses of greatly elongated *Usneas* and *Ramalinas*, so characteristic of the Californian coastal woods. Lichens there are in plenty, and the *Parmelia saxatilis* formation is really quite marked on the small limbs of various trees, but the lowland lichens are not flaunted to the breeze or markedly evident. One must hunt for them. My first impressions of the lichen flora in the Puget Sound forest were painfully disappointing.

I have had very little opportunity to do any botanical work since coming to Washington, and though I have collected at every opportunity much of my material is as yet unworked. I have observed the lichens over most of the lowland, have made one trip into the mountains immediately bordering the lowland, and thrice have ascended Mt. Baker. It is to be regretted that I have

been unable to visit the ranges lying further eastward where one may confidently expect a considerable increase to the tentative list of 124 names herewith appended:

VERRUCARIA NIGRESCENS Pers. Rare; on Sumas Mt. at 2500 feet. Specimens not typical, spores $9\frac{1}{2}$ –10 by $16\frac{1}{2}$ –22 μ .

VERRUCARIA PULVERULENTA Ach. Occurring with *Graphis scripta* on bark in the lowlands.

CALYCIUM HYPERELLUM Ach. Abundant on the trunks of *Pseudotsuga mucronata*, along the upper portions, 50 feet and more from the ground.

CALYCIUM POLYPORAEUM Nyl. On a *Polyporus*, Sumas Mt., at 2000 feet.

CYPHELIUM INQUINANS (Sm.) Trevis. Abundant on lower portion of trunks of large specimens of *Pseudotsuga mucronata*; throughout the lowlands; spores smaller than I find them elsewhere, 8 by 11–13.5 μ . Also occurring on old cedar rails and posts.

SPHAEROPHORUS GLOBOSUS (Huds.) Herre. Abundant on tree trunks; slopes of Mt. Baker, 1000 to 4000 feet.

ARTHONIA RADIATA (Pers.) Th. Fr. Common on trees in the lowlands.

ARTHONIA RADIATA var. SWARTZIANA (Ach.) Willey. On bark of *Acer circinatum*.

OPEGRAPHIA VARIA Pers. Very abundant on the trunks of large specimens of *Populus trichocarpa* along the Nooksack river, and also on *Acer macrophyllum* in the forested lowlands.

GRAPHIS SCRIPTA (L.) Ach. Very common on various smooth barked trees.

GRAPHIS SCRIPTA PULVERULENTA Ach., and other varieties also occur.

THELOTREMA LEPADINUM Ach. On alder, Sumas Mt., at 1600 feet.

LECIDEA SANGUINEO-ATRA (Wulf.) Ach. On *Pseudotsuga mucronata*.

LECIDEA RUBIFORMIS Wahlenb. On earth and rocks; Mt. Baker, at 6000 feet. Spores small, 4 by 5–8 μ .

LECIDEA CONTIGUA Fr. On Mt. Baker above the snow line; specimens not typical; spores sub-globose, ovoid ellipsoid, and ellipsoid, $7\frac{1}{2}$ –12 $\frac{1}{2}$ by 12–20 μ .

LECIDEA TESSELLATA Flk. On rocks, Mt. Baker; poorly developed.

LECIDEA ARCTICA Sommerf. On dead moss, Mt. Baker, 6000 to 7000 feet. Spores 8 by 13–16 μ , with conspicuous oil drops.

LECIDEA RIVULOSA Ach. Mt. Baker above snow line; occurring on dead moss, in very tiny patches mixed with other lichens.

LECIDEA PARASEMA Ach. Common on various trees in the lowland.

LECIDEA ANTHRACOPHILA Nyl. The late Dr. Hasse and myself both placed this specimen here though the spores are short for the species. On a charred stump at 2000 feet elevation, Sumas Mt.

MEGALOSPORA SANGUINARIUS (L.) Th. Fr. Occasional on bark of Douglas spruce in the lowlands.

BACIDIA ALBESCENS (Anzi) Zwackh. On the shaded side of *Sambucus* and on Douglas spruce; spores 1.4–2.7 by 38–44 μ .

BACIDIA FUSCO-RUBELLA (Hoffm.) Arn. On Sumas Mt.; spores 2.5–3 by 47–72 μ .

RHIZOCARPON PETRAEUM (Wulf.) A. Zahlbr. Hardly agreeing with typical form but not belonging elsewhere. Sumas Mt., at 2500 feet.

RHIZOCARPON GEMINATUM (Elot.) Koerber. With *R. geographicum*; spores 13-22 by 21-40 μ .

RHIZOCARPON GEOGRAPHICUM (L.) DC. At 5500 feet and above on Mt. Baker.

BAEOMYCES BYSSOIDES (L.) Schwer. Common on old stumps, logs, and on earth, in the wooded lowlands.

STEREOCAULON PASCHALE var. *CONGLOMERATUM* Fries. Not rare on the slopes of Mt. Baker, especially above the snow line. We may have two or more species but the material is too depauperate to place with certainty.

THAMNOLIA VERMICULARIS (Sw.) Ach. Abundant on exposed patches of soil amid the snow fields of Mt. Baker at 6000 feet and above.

CLADONIA RANGIFERINA (L.) Web. Rare; on Mt. Baker, 4500 feet.

CLADONIA SYLVATICA (L.) Hoffm. Rare; Mt. Baker, at about 5000 feet.

CLADONIA BELLIDIFLORA (Ach.) Schaer. On rocks, Mt. Baker, 4500 feet.

CLADONIA MACILENTA Hoffm. Occasional on rotten logs and stumps throughout, at least to an elevation of 4000 feet.

CLADONIA BACILLARIS (Del.) Nyl. On rotten logs in the lowlands and foothills.

CLADONIA CRISTATELLA Tuck. On Mt. Baker at 5000 feet.

CLADONIA VERTICILLATA Hoffm. var. *EVOLUTA* Th. Fr. On rotten logs in the foothills.

CLADONIA SQUAMOSA (Scop.) Hoffm. On rotten logs in lowland and foothills.

CLADONIA GRACILIS DILACERATA Floerke. This, and several other varieties, occur on mossy logs in the forested lowlands.

CLADONIA PYXIDATA (L.) Fr. Common in the lowlands on mossy logs and stumps.

CLADONIA FURCATA RACEMOSA Floerke. On Lummi Island and probably throughout the mainland of the county.

While we have a number of species of *Cladonia* they are not specially conspicuous. The above list will be readily added to when they are further collected.

PILOPHORON CEREOLUS HALLII Tuck. Common on rocks, especially among mosses on the under side of overhanging ledges; Sumas Mt., 2500 feet, and Mt. Baker at 4500 feet.

PILOPHORON CEREOLUS ACICULARIS (Ach.) Tuck. Common on Mt. Baker at from 4000 to 5000 feet.

The *Gyrophora* group is not particularly well developed or represented here in my collections as yet. All my trips on Mt. Baker have been on the north or northwest side and I have no doubt that further investigation on the southward slopes will reveal a number of other species as well as a more abundant growth of the species here indicated. The five here listed are all from Mt. Baker at 6000 feet (the glacier line on the northwest) and above.

GYROPHORA CYLINDRICA (L.) Ach.

GYROPHORA RETICULATA (Schaer.) Th. Fr.

GYROPHORA HYPERBOREA (Hoffm.) Ach.

GYROPHORA RUGIFERA (Nyl.) Th. Fr.

GYROPHORA EROSA (Web.) Ach.

A stranger would naturally anticipate a large development of the Collemaeous lichens but they are few and far between in all the localities thus far visited. But one species of *Collema* has thus far been determined with certainty and three of *Leptogium*, while at no place are they abundant.

COLLEMA NIGRESCENS (Leers) Wainio. Among mosses on trunks of *Acer macrophyllum*.

COLLEMA sp. Material small, sterile; growing among mosses near the snow line on Mt. Baker.

LEPTOGIUM TENUISSIMUM (Sm.) Koerber. On *Selaginella* sp., at 1600 feet on Sumas Mt.

LEPTOGIUM PALMATUM (Huds.) Mont. On earth at 2000 feet; Sumas Mt.

LEPTOGIUM PULCHELLUM (Ach.) Nyl. Among mosses on the trunks of *Acer macrophyllum*, probably throughout the lowlands, but rare everywhere; determination somewhat doubtful, material submitted to Dr. Fink, and Dr. Hasse, was not recognized by them and it does not agree with any material seen by me or descriptions read but evidently belongs under the type of *pulchellum*.

LEPTOGIUM TREMELLOIDES (L.) Gray. A minute specimen of this was found growing with *Parmeliella microphylla*, on rocks on Sumas Mt.; spores 8-10 by 18-27 μ .

HEPPIA VIRESCENS (Despr.) Nyl. 7000 feet and above, Mt. Baker, on dead mosses.

MASSALONGIA CARNOSEA (Dicks.) Koerber. Same locality as, and mixed with, *Heppia virescens*.

PARMELIELLA MICROPHYLLA (Sw.) Müll. Arg. Among mosses on rocks; slopes of Mt. Baker and Sumas Mt., and undoubtedly common everywhere in the mountains.

PARMELIELLA CYANOLEPRA (Tuck.) Herre. Sterile; Sumas Mt. at 1800 feet.

PARMELIELLA LEPIDIOTA (Sommerf.) Herre (?). A sterile lichen occurring on Mt. Baker and Sumas Mt. is with little doubt this species.

LOBARIA PULMONARIA (L.) Hoffm. On various trees but not common, throughout the lowlands; very abundant in the rainy forest belt on the slopes of Mt. Baker between 1000 and 3000 feet.

LOBARIA OREGANA (Tuck.) Herre. Very abundant on trunks of hemlocks on Mt. Baker from 3000 to 5000 feet elevation.

STICTA ANTHRASPIS Ach. Rare; near Glacier at about 1000 feet elevation; specimens small and sterile.

NEPHROMA HELVETICA Ach. On *Acer circinatum*, Glacier, elevation 950 feet.

SOLORINA CROCEA (L.) Ach. Abundant and very finely developed on earth amid the Mt. Baker snow fields at 7000 feet and above.

PELTIGERA APHTOSA (L.) Hoffm. On earth, stumps, and rotting logs; common at all altitudes up to 8000 feet.

PELTIGERA VENOSA (L.) Hoffm. Not rare on mossy earth at lower elevations.

PELTIGERA POLYDACTYLA (Neck.) Hoffm. On the slopes of Mt. Baker.

PELTIGERA CANINA (L.) Hoffm. Common everywhere on earth, logs, and stumps.

PELTIGERA CANINA MEMBRANACEA (Ach.) Nyl. Abundant and finely developed in the lowlands and lower slopes of the mountains.

PELTIGERA CANINA SPURIA (Ach.) Tuck. A few specimens obtained from Mt. Baker.

PERTUSARIA AMARA (Ach.) Nyl. On trunks of trees in the lowlands.

PERTUSARIA MULTIPUNCTA (Turn.) Nyl. On trunks of birch.

PERTUSARIA PERTUSA (L.) Nyl. On various barks in the lowlands.

PERTUSARIA LEIOPHACA (Ach.) Schaer. On bark of both species of maple, in the lowlands.

PERTUSARIA PUSTULATA (Ach.) Nyl. (?) The apothecia of this lichen yield me no spores, but it is nearest this species.

LECANORA GELIDA (L.) Ach. Abundant in the mountains at 2000 feet and upward wherever there are rock exposures; occasional in the lowlands on erratic glacial boulders.

LECANORA PACIFICA Tuck. Abundant on bark of various deciduous trees in the lowlands.

LECANORA SUBFUSCA (L.) Ach. Common in same localities as above; several varieties occur.

LECANORA COILOCARPA (Ach.) Nyl. On *Acer macrophyllum*, in lowlands.

LECANORA HAGENI Ach. On bark in lowlands and very finely developed on rocks, Mt. Sumas, at 2500 feet.

LECANORA VARIA (Ehrh.) Ach. On bark of various deciduous trees, in lowlands.

LECANORA POLYTROPA Nyl. What I take to be this occurs on the thallus of other lichens; locality Mt. Baker, above 6000 feet.

LECANORA FRUSTULOSA (Dicks.) Ach. Rare; Mt. Baker.

LECANORA ALPINA Sommerf. Rare; small patches among *Rhizocarpon geographicum*; Mt. Baker, above snow line.

LECANORA GIBBOSA (Ach.) Nyl. Specimens scanty and very dark, resembling sea-coast aberrant forms from the Santa Cruz Peninsula; on Sumas Mt., at 2500 feet.

ICMADOPHILA ERICETORUM (L.) A. Zahlbr. On old logs and stumps, in the lowlands.

OCHROLECHIA TARTAREA (L.) Mass. Common throughout the forested regions.

LECANIA DIMERA (Nyl.) Oliv. Occasional on smooth barks in the lowlands.

CANDELARIELLA CERINELLA (Flk.) A. Zahlbr. On rocks with other lichens; Mt. Baker, 6000 feet altitude; also on Sumas Mt. at 2500 feet.

PARMELIA PERLATA (L.) Ach. A poorly developed, sterile lichen which I take to be this species is occasional on fences, roofs, and limbs of trees.

PARMELIA SAXATILIS (L.) Ach. Commonest of all our foliaceous lichens, on all sorts of trees and often absolutely covering branches and twigs of deciduous native and cultivated trees. The individual thalli are small and sterile as a rule, but not rare in fruit on Lummi Island.

PARMELIA FULIGINOSA (E. Fr.) Nyl. Common on various barks but small and poorly developed.

PARMELIA PUBESCENS (L.) Wainio. Common and fertile on rocks at the snow line and above on Mt. Baker.

PARMELIA PHYSODES (L.) Ach. Common on bark and old fences.

PARMELIA ENTEROMORPHA Ach. On dead and living trees of all sorts throughout the forested regions and on old fences. Some of our material has a very close resemblance to *Parmelia lugubris*.

CETRARIA GLAUCA (L.) Ach. On mossy logs and trees throughout.

CETRARIA LACUNOSA STENOPHYLLA Tuck. Common in the forests of Mt. Baker.

CETRARIA TUCKERMANI Herre. Abundant on trees in the Mt. Baker forest.

CETRARIA CHLOROPHYLLA (Humb.) Wainio. On twigs and old fences in the lowlands.

CETRARIA ISLANDICA (L.) Ach. On Mt. Baker from a little below the snow line upward.

NEPHROMOPSIS CILIARIS (Ach.) Hue. On various conifers in the mountains and on birch bark in the lowlands.

NEPHROMOPSIS PLATYPHYLLA (Tuck.) Herre. Abundant on bark of *Abies* sp., on Mt. Baker at 6000 feet.

EVERNIA PRUNASTRI (L.) Ach. Common on trees and fences in the lowlands.

LETHARIA VULPINA (L.) Wainio. Common enough on bark of Douglas spruce, but small, poorly developed, and sterile. Thus far I have seen nothing corresponding to the luxuriant growth so conspicuous in the high Sierras of California.

ALECTORIA JUBATA IMPLEXA (Hoffm.) Ach. On various trees, living and dead, at 6000 feet on Mt. Baker; well developed but sterile. Also at all levels below down to less than 100 feet, but very small.

ALECTORIA SARMENTOSA Ach. On various trees on Mt. Baker, intertwined with the preceding species.

ALECTORIA OREGANA Nyl. A sterile lichen occurs on Mt. Baker on the bark of *Abies* which I place here; it does not quite accord with the luxuriant specimens collected by me in California.

RAMALINA INFLATA Hook. & Tayl. Not common; on trunks of trees in the lowlands and lower mountain slopes.

RAMALINA RETICULATA (Noehd.) Krempelh. Abundant on Lummi Island.

USNEA FLORIDA (L.) Weber. Common throughout but poorly developed; on twigs, tree trunks, and fences.

USNEA HIRTA (L.) Hoffm. Likewise common but rather poorly developed.

USNEA PLICATA (L.) Weber. On trees throughout but not specially notable.

USNEA DASYPOGA (Ach.) Nyl. Neither abundant nor well developed, but found throughout on trees and fences.

BLASTENIA ATROSANGUINEA (Merrill) Herre. Not rare on *Acer circinatum* and occasional on other trees in the lowlands. Spores simple to bi- and polarilocular, 5-7 by 10-16 μ .

CALOPLACA ELEGANS (Link) Th. Fr. Mt. Baker, on rocks at 5000 feet and upward.

CALOPLACA JUNGERMANNIAE (Vahl) Th. Fr. Found in tiny patches on mosses; Mt. Baker, 6000 feet.

XANTHORIA POLYCARPA (Ehrh.) Th. Fr. Abundant throughout the lower levels on fruit trees, fences, and twigs of various forest trees.

BUELLIA PARASEMA (Ach.) Th. Fr. Common on smooth barks in the lowlands.

BUELLIA ALIENA (Nyl.) Herre, var. PENICHTA (Tuck.) Herre. On bark of *Pseudotsuga mucronata*, Sumas Mt., at 1700 feet; spores 12.3-16 by 21-27 μ .

BUELLIA ALBO-ATRA (Hoffm.) Th. Fr. Common on trunks of trees, especially Douglas spruce.

BUELLIA PAPILLATA (Sommerf.) Tuck. Overrunning dead mosses; Mt. Baker, 7000 feet.

I also have one or two additional species of rock Buellias which I have not yet satisfactorily determined.

RINODINA HALLII Tuck. On smooth barks in the lowlands.

RINODINA EXIGUA (Ach.) Th. Fr. Occasional with *Lecidea parasema*.

RINODINA TURFACEA (Wahl.) Nyl. In very tiny patches on mosses; Mt. Baker, 6000 feet, mixed with *Caloplaca jungermanniae*.

PHYSCIA AIPOLIA (Ach.) Nyl. On *Acer macrophyllum*, in the lowlands.

PHYSCIA TENELLA (Scop.) Nyl. Common on apple trees in the lowlands.

PHYSCIA PULVERULENTA (Schreb.) Nyl. Growing on moss on Mt. Baker at 6000 to 7000 feet; material sterile and small.

STATE NORMAL SCHOOL,
BELLINGHAM, WASHINGTON

NOTES ON NORTH AMERICAN SPHAGNUM:—VII.

A. LE ROY ANDREWS

The Group Cuspidata Lindberg (Continued)

16. *Sphagnum recurvum* Beauvois, 1805. An earlier name, *S. intermedium* Hoffmann, 1795¹ has been used by some authors for this species, but its status is so uncertain² that it has been rather generally and probably justly abandoned.

¹ Dr. Barnhart has called my attention to the fact that while the second volume of *Deutschlands Flora* was not published until 1796, a portion containing *Sphagnum* came out shortly before the close of 1795; cf. Hoppe, *Botanisches Taschenbuch*, 1796, 243ff.

² The whole question is discussed in considerable detail by Dusen in *Sphagnacearnas utbredning*, 42ff. 1887.